P.13 The Use of Apatite for Chemical Stabilization of Subsurface Contaminants: Phosphate-Induced Metals Stabilization (PIMS) for Remediation of Radionuclides and Heavy Metal Contaminants at DOE Sites

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Abstract

Metal contaminants of concern occurring in soil and groundwater at several of the major U.S. Department of Energy (DOE) sites include uranium, chromium, lead, mercury, cadmium, arsenic, and barium. Cost-effective means are required to minimize the migration of these toxic metals into previously clean areas or the leaching of these metals into groundwater systems that can spread the contamination. One attractive approach to minimizing the adverse impact of these metals is use of chemical precipitation to modify the chemical form of the metal in order to decrease its solubility in water and render the modified metal compound immobile in the soil phase. This in turn may reduce the bioavailability and thus the potential toxicity of the metal.

Some of the more frequently encountered metals of concern (notably uranium, lead and cadmium) are known to form highly insoluble phosphate salts (mineral phases, some of which occur naturally as geologically stable metal ores), and several other metals may also be amenable to phosphate treatment. An economical means to provide a continuous low level of reactive phosphate in-situ is the use of apatite (a calcium phosphate mineral phase), applied at low dosage as a soil amendment. An optimal material for use in this application is Apatite II, supplied by PIMS-NW, Inc.

The National Energy Technology Laboratory, on behalf of needs identified by the DOE Subsurface Contamination Focus Area, sponsors the current research program. The versatility and technical feasibility of the PIMS approach will be demonstrated and critically evaluated at the Materials and Chemistry Laboratory in Oak Ridge, Tennessee, with use of twelve selected metals in aqueous solution and in soil. These selected metals will be representative of contaminants commonly found at DOE and EPA Superfund sites. The study will evaluate the leaching of metals from contaminated soils, with and without apatite amendment. Soil columns will also be used to study the extent to which apatite amendment can retard the migration of contaminants added to an aqueous influent. A suite of instrumentation (including inductively coupled plasma emission, x-ray fluorescence, and x-ray diffraction) will be used to identify the mineralogy, loading, and distribution of metal bearing solid phases produced within treatment media, and the phases that are identified will be compared to thermodynamic prediction.